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(54) Checking tyre pressures

(57) In a process for checking the air pressure in the tyres (12, 14, 16, 18) of motor vehicle wheels, by means of a measurement unit (32) arranged in or on the tyre of each wheel, in which a pressure signal is provided by a respective transmitter unit (31) and received by a remote receiver unit (22) together with an identification value characteristic of the respective transmitter unit, and by means of a control unit (21), the identification value of the transmitter unit is compared with reference identification values allocated to the respective transmitter units, allocation of the respective position (VL, VR, HL, HR) of the motor vehicle wheel to the signals is carried out by a bi-directional data transfer process, in which an activation signal (AS) generated by the control unit is selectively passed to a respective motor vehicle wheel as a long-wave signal (LWS), the long-wave signal is respectively allocated to a transmitter unit which generates a long-wave identification signal therefrom, a data signal (DS) containing the long-wave identification signal and the identification value of the respective transmitter unit is provided by the transmitter unit to the control unit as a high-frequency signal, and the position of the wheel is identified by the control unit on the basis of the long-wave identification signal.

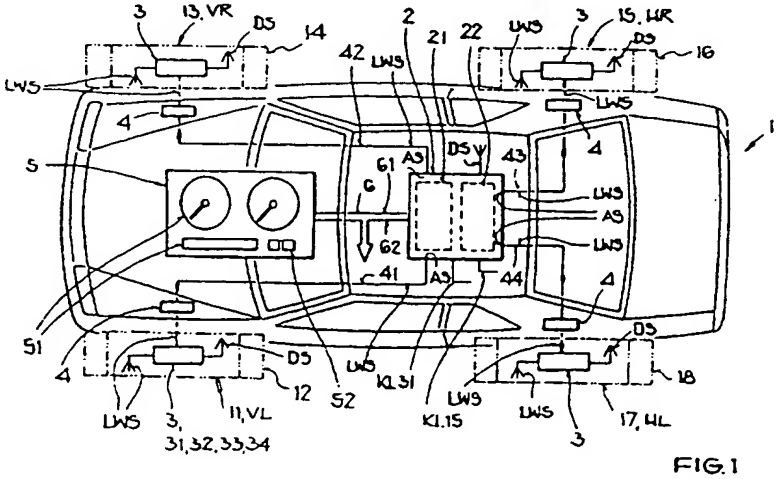

FIG.1

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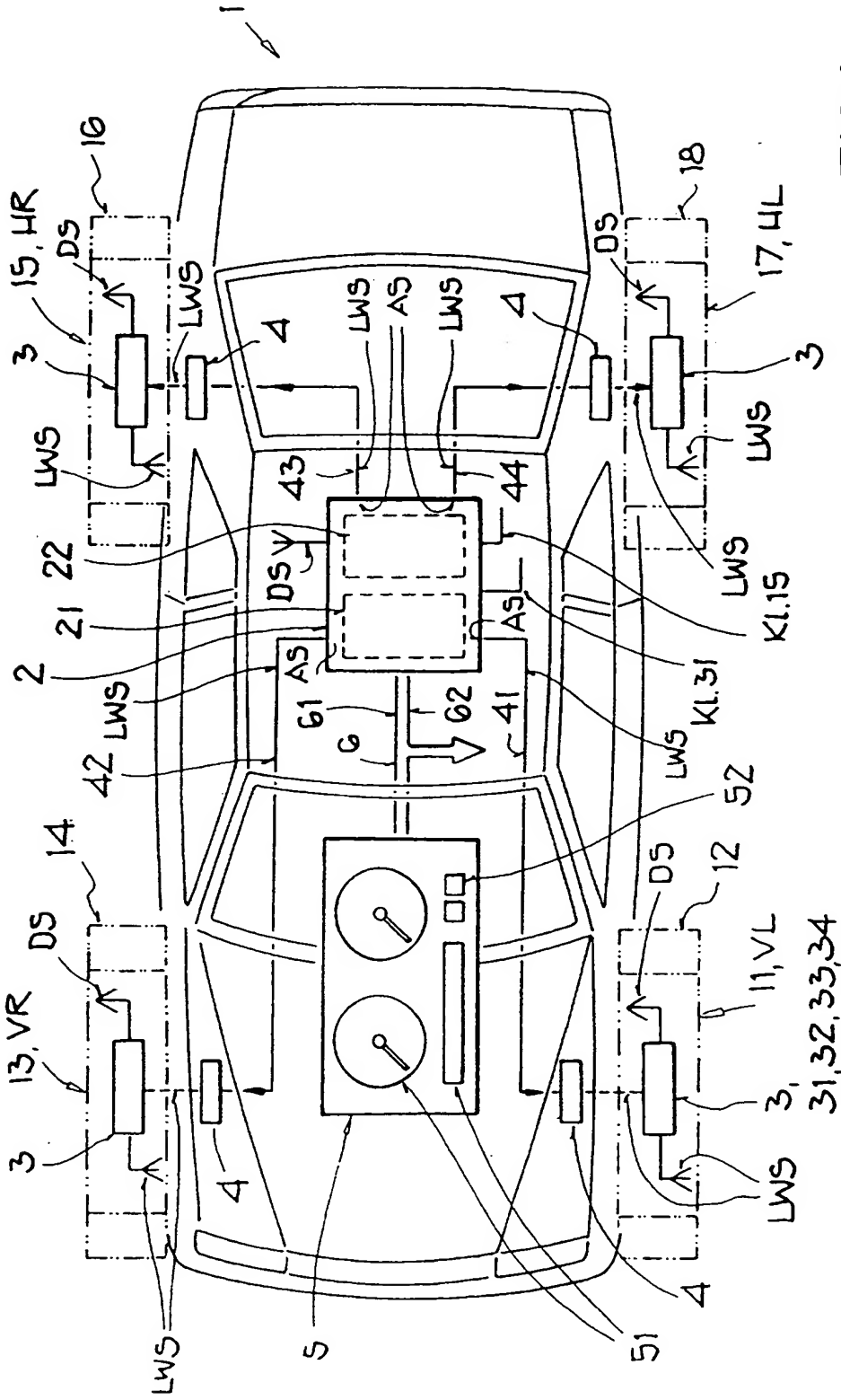


FIG.1

FIG. 2

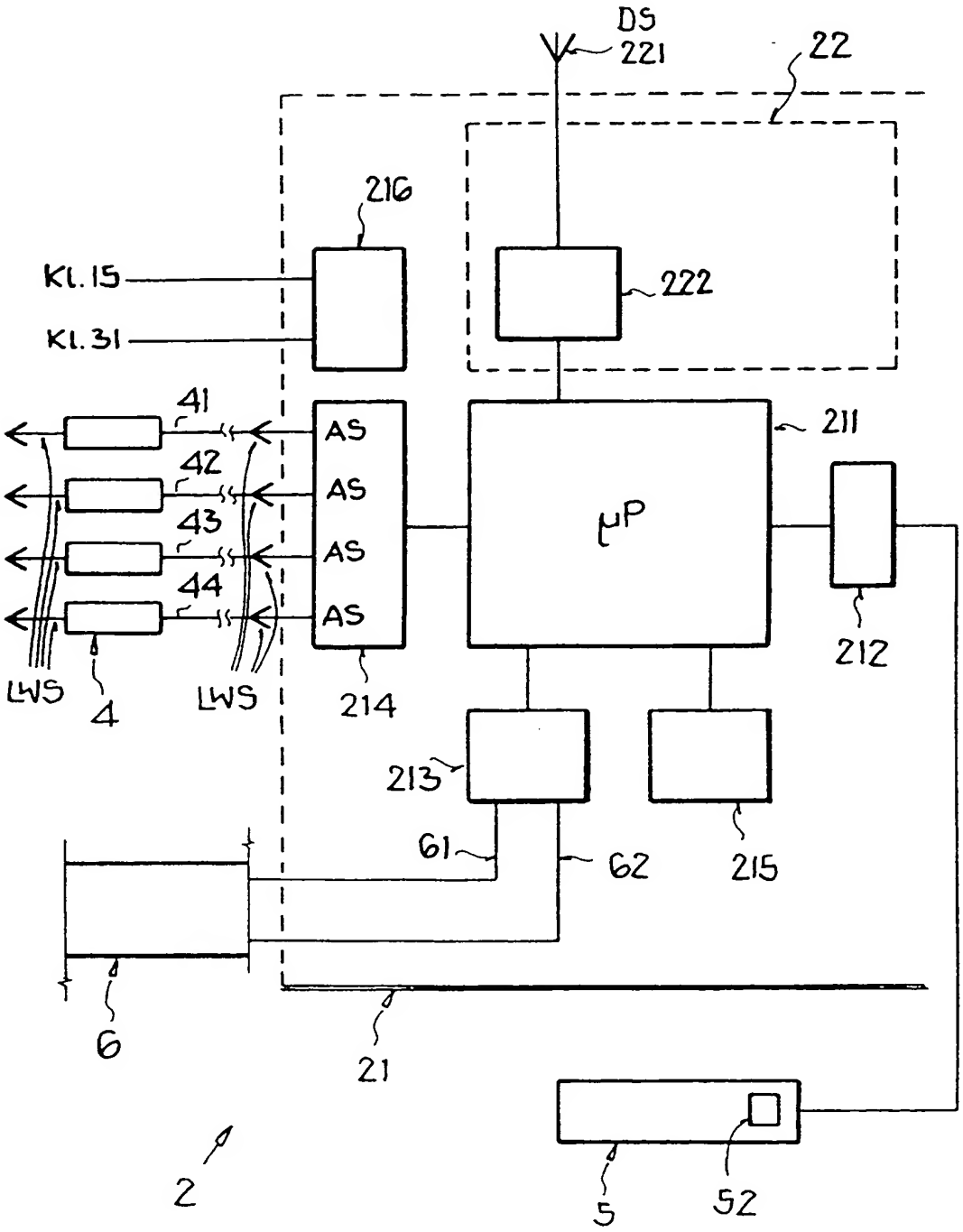
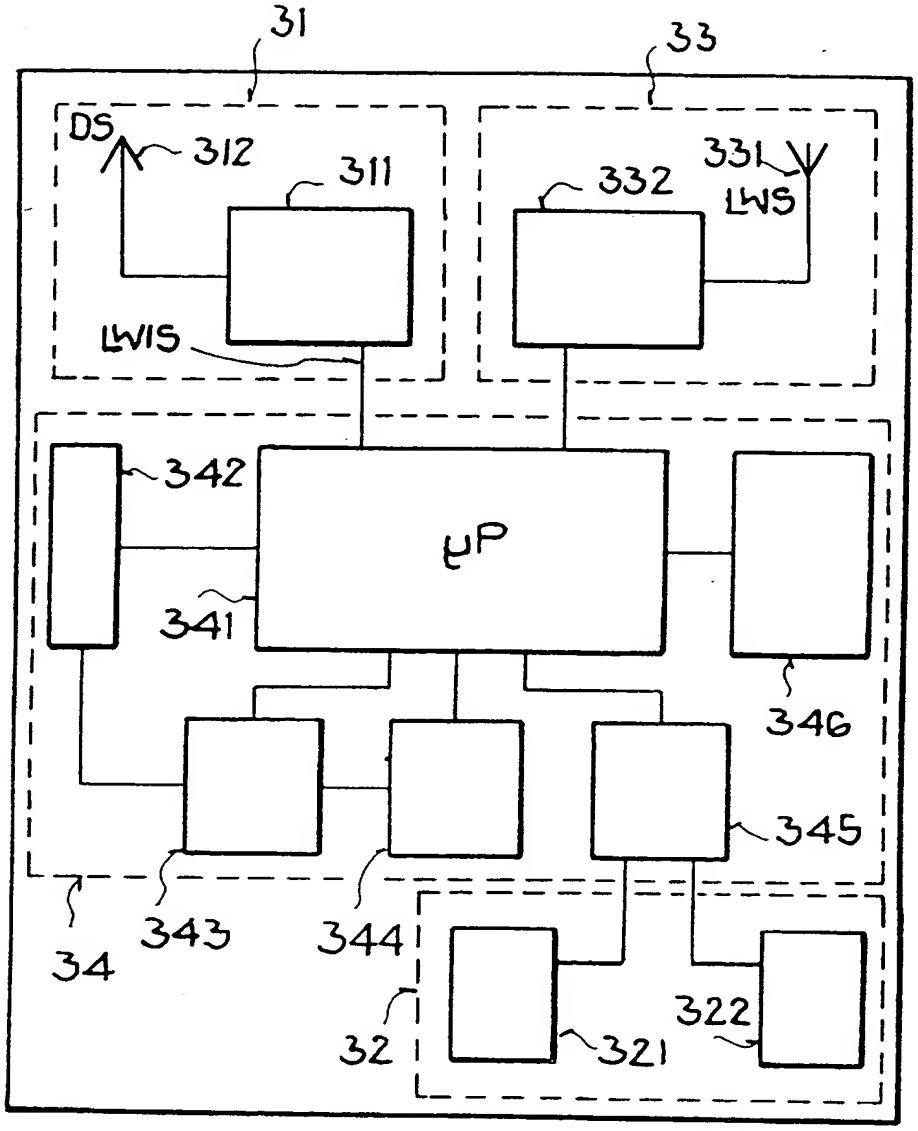


FIG.3



Checking Tyre Pressures

The invention relates to a process for checking the air pressure in tyres, especially of motor vehicle wheels as is known from EP 0 626 911 B1.

The correct adjustment of the air pressure in the tyres of motor vehicle wheels is very important for reasons of economy and driving safety. An incorrectly adjusted air pressure, i.e. one that is too high or too low, leads on the one hand to increased tyre wear, as a result of which the tyres have to be replaced prematurely, and to increased fuel consumption, and on the other hand causes increased flexing work of the tyre flanks or walls, as a result of which the temperature of the tyre is greatly increased and the tyre may be destroyed (in particular at high speeds of the motor vehicle), which frequently leads to serious traffic accidents. For these reasons, the air pressure in the tyres should and must be checked regularly, even daily in the case of commercial vehicles. However, this checking is often left undone, since measurement of the air pressure in the tyres is a relatively tedious and dirty job, which moreover requires a certain amount of technical skill. Therefore, processes are already known, e.g. from DE 39 30 479 A1, for measuring the air pressure in the tyres of motor vehicle wheels by means of a pressure sensor arranged on the motor vehicle wheel, and indicating the measured signal of the air pressure to the driver in a suitable manner.

In the process disclosed in EP 626 911 B1, the pressure prevailing in the air chamber of the motor vehicle wheel is detected by means of a pressure measurement unit arranged in or on the tyre of each motor vehicle wheel, and an electrical signal representative thereof is provided. From the electric signal a data signal consisting of the measured value of the air pressure and an identification value is generated and emitted by means of a transmitter unit arranged in or on the tyre of each motor vehicle wheel (e.g. directly on the valve). Detection of the data signals

emitted by the transmitter unit is carried out by means of a receiver unit arranged fixedly on or in the motor vehicle, and evaluation of the data signals is carried out by means of a control unit. For reasons of reliability of data transfer between the transmitter units and the receiver unit (protection against disturbance signals), the receiver unit has reference values for identification, which are allocated to the respective identification values of the transmitter units (accordingly, the identification value and the allocated reference values for identification are either identical or are in a specific relationship to one another); further processing of the data signal only occurs when the identification value emitted by the transmitter unit and received by the receiver unit is identical to the reference value for identification of the receiver unit or is allocated thereto.

The reference value for identification may be varied to permit a (variable) allocation of the positions of the motor vehicle wheels (e.g. upon replacement of a tyre or upon changeover from summer tyres to winter tyres, and vice versa); for this, a switching unit enables a switchover of the receiver unit from normal operating mode, in which the air pressure is checked, into a pairing mode, in which the receiver unit receives the identification value emitted by each transmitter unit and stores it as a reference value for identification together with an allocation of the respective wheel position. The disadvantage here is that the allocation or definition of the positions of the motor vehicle wheels is complex and does not occur automatically.

The present invention seeks to provide a process of the above-mentioned type, through which a simple and automatic allocation of the positions of the motor vehicle wheels occurs.

According to the present invention there is provided a

process for checking the air pressure in the tyres of motor vehicle wheels, in which by means of:

- a measurement unit arranged in or on the tyre of each motor vehicle wheel, at least one pressure signal characteristic of the air pressure is recorded as measurement signal;
- a transmitter unit arranged in or on the tyre of each motor vehicle wheel, a data signal (DS) containing at least one measured value of the air pressure derived from the pressure signal and an identification value characteristic of the respective transmitter unit is generated and emitted;
- a receiver unit arranged at a distance from the motor vehicle wheels, the data signal (DS) emitted by the transmitter units is received;
- a control unit, the identification value of the transmitter unit is compared in the data signal (DS) with the reference identification values allocated to the respective transmitter units in such a way that further processing of the data signal (DS) through the control unit only occurs when the identification value and the reference identification value meet a pre-set allocation criterion;
- the allocation criterion, allocation of the respective position (VL, VR, HL, HR) of the motor vehicle wheel is carried out, in which the variable reference identification value is adapted to the identification value of the respective transmitter unit,

wherein the allocation of the respective position (VL, VR, HL, HR) of the motor vehicle wheel to the data signals (DS) is carried out by means of a bi-directional data transfer process, in which

- an activation signal (AS) generated by the control unit is selectively passed to a respective motor vehicle wheel as a long-wave signal (LWS);
- the long-wave signal (LWS) is respectively received by a long-wave unit arranged in or on each motor vehicle wheel and respectively allocated to a transmitter unit;
- the long-wave signal (LWS) is made available by the long-

wave unit to the respectively allocated transmitter unit which generates a long-wave identification signal (LWIS) therefrom;

- a data signal (DS) containing the long-wave identification signal (LWIS) and the identification value of the respective transmitter unit is emitted by the transmitter unit to the control unit as a high-frequency signal, and
- the position (VL, VR, HL, HR) of the motor vehicle wheel is identified by the control unit on the basis of the long-wave identification signal (LWIS).

In the above process, allocation of the position of the motor vehicle wheels to the data signals is performed by means of a bi-directional data transfer process between the control unit or receiver unit and the motor vehicle wheels. In this case, an activation signal (frequency 60 kHz, for example) is generated by the control unit and selectively passed as a long-wave signal to a respective long-wave unit arranged on the motor vehicle wheel or in the vicinity of the motor vehicle wheel (for example, by means of a line connection), whereby a long-wave unit is allocated to each motor vehicle wheel. This long-wave signal is made available by the long-wave unit to the transmitter unit arranged in the motor vehicle wheel and allocated to this long-wave unit, e.g. by inductive coupling; the long-wave signal is processed by the transmitter unit and a long-wave identification signal generated therefrom - the long-wave identification signal accordingly contains the information as to which motor vehicle wheel has been selected for the allocation of its position. The data signal containing the normal measured data, the identification value and, if applicable, the long-wave identification signal is transmitted by the transmitter unit to the control unit as an hf signal (carrier frequency 433.92 MHz, for example). The incoming data signal is evaluated by the control unit, in particular it is checked whether a long-wave

identification signal is contained in the data signal; since only one of the data signals emitted by the transmitter units can have a long-wave identification signal, an allocation of the position of the motor vehicle wheel is easily possible on the basis of the identification value of the transmitter unit contained in the data signal, since the motor vehicle wheel subjected selectively to the activation signal (long-wave signal) by the control unit is known to said control unit.

In this case, the allocation of the motor vehicle wheels can be carried out according to specific criteria or in the presence of specific conditions: for example, every time the engine is started, at regular time intervals (e.g. every hour), after a specific distance has been travelled (e.g. every 1000 kilometres), depending on the travelling speed, for example, or after manual request from the driver or operator (e.g. after changing the tyres etc.).

The long-wave identification signal can be generated in a variety of ways on the basis of the long-wave signal and included in the data signal; for example, the long-wave identification signal can be generated as the counter reading of a counter, which in the case of a "positive" long-wave identification signal clearly differs from the counter reading in the case of a "negative" long-wave identification signal, or may be in the form of a voltage value of an analog integrator.

The display value of the air pressure and/or a warning in the case of a false air pressure (too high or too low a value) can be indicated visually or optically or acoustically or haptically or by sense of touch to the driver by means of a display unit when specific thresholds have been reached.

A preferred embodiment of the present invention will now be

described, by way of example only, with reference to the accompanying drawings, of which:

Figure 1 is a top view of a motor vehicle with the system components for carrying out the process;
Figure 2 is a block diagram of the control module comprising the control unit and receiver unit; and
Figure 3 is a block diagram of the wheel module comprising the control unit, measurement unit and long-wave receiver unit.

According to Figure 1, the process for checking the air pressure in the tyres 12, 14, 16, 18 of motor vehicle wheels 11, 13, 15, 17 of the motor vehicle 1 and the allocation of the position VL, VR, HL, HR of the motor vehicle wheels 11, 13, 15, 17 is carried out with the following components:

- a control module 2, constructed, for example, as a separate control device or integrated in a control device, comprising a control unit 21 and receiver unit 22;

- a wheel module 3, arranged in or on the tyres 12, 14, 16, 18 of the vehicle wheels 11, 13, 15, 17, comprising a control unit 31, measurement unit 32, long-wave receiver unit 33 and control unit 34, which transfers a data signal DS as hf signal to the control module 2;

- a long-wave unit 4, which is arranged in or on, or in the vicinity of each motor vehicle wheel 11, 13, 15, 17 (e.g. in the wheel case or guard) and respectively allocated to a wheel module 3, and which is activated by means of an activation signal AS generated by the control module 2 and transferred on lines 41, 42, 43, 44 as a long-wave signal LWS, and which makes this long-wave signal LWS available to the allocated wheel module 3 (of the long-wave receiver unit 33) after activation (e.g. by means of

radio inductive transmission);

- a fittings module 5 comprising a display unit 51 for (digital and/or analog) display of various display values (e.g. of the air pressure) or warning messages (e.g. from an optical warning light or an acoustic warning) and comprising an operating unit 52 with keys and/or switches (e.g. for manual activation of the control module 2);

- a data transfer array 6, which is constructed, for example, as a data bus, and connects the control module 2 to the fittings module 5 and further control devices of the motor vehicle 1 (e.g. via data lines 61, 62).

According to Figure 2 showing the control module 2, the control unit 21 as main component contains a microprocessor 211 for signal/data processing and control of the time curve, an input 212, to which the operating unit 52 of the fittings module 5 is connected, an interface 213 for connection to the data bus 61, 62 (e.g. a bus interface 213 for connection to the two bus lines 61, 62 of a CAN data bus 6), a long-wave transmitter 214 for supplying a long-wave signal LWS to a respective long-wave unit 4 by means of lines 41, 42, 43, 44, a supervisory circuit 215 ("watch dog") and a power pack 216 connected, for example, to the battery (Kl.15, Kl.31) of the motor vehicle 1 with surge voltage protection and polarity safeguard to ensure voltage supply.

The receiver unit 22 comprises a (hf) receiver antenna 221 to pick up the data signal DS emitted by the transmitter units 31 of the wheel module 3 and an hf receiver 222, which is tuned to the frequency of the data signal DS and makes the data signal DS available to the microprocessor 211 for further processing.

According to Figure 3 showing the wheel module 3, the

transmitter unit 21 comprises an hf transmitter 311 for generating an hf data signal DS (e.g. with the frequency 433.92 MHz) and an hf antenna 312 for emitting the data signal DS (transmission to the control module 2).

The control unit 34 comprises a microprocessor 341, or alternatively an application-specific integrated circuit (ASIC), for control of the time curve of the process and for signal/data processing, a (lithium) battery 342 to assure voltage supply of the wheel module 3, a power supply component 343, a time counter 344 to pre-set a specific time cycle or counter value, a D/A converter 345 to convert the analog measured values of the measurement unit 32 into digital output values and an interface circuit 346 for the parametric assignment sensor-specific measured values.

The measurement unit 32 contains various sensors to pick up the measured values of specific measured magnitudes, e.g. a pressure sensor 321 to pick up the air pressure in the tyres 12, 14, 16, 18 and a temperature sensor 322 to pick up the temperature of the tyres 12, 14, 16, 18.

The long-wave receiver unit 33 comprises a long-wave antenna 331 to pick up the long-wave signal LWS transferred from the allocated long-wave unit 4 and a long-wave receiver 332 (e.g. for the frequency range of 40 to 80 kHz) for preparation of the long wave signal LWS prior to forwarding to the microprocessor 341 of the control unit 34, which generates the long-wave identification signal LWIS from this. An integrated circuit (IC) used to receive long-wave time signal transmitters in radio clocks may be used, for example, as the long-wave receiver 332.

The arrangement of the long-wave units 4, for example, containing coils, in the vicinity of the respectively allocated wheel module 3 assures that the individual motor vehicle wheels 11, 13, 15, 17 can be selected individually

by means of the long-wave signal LWS without cross talk to other motor vehicle wheels occurring. As a result, a clear allocation of the position VL, VR, HR, HL of the motor vehicle wheels 11, 13, 15, 17 to the data signals DS transferred by the transmitter units 31 of the wheel module 3 can occur on the basis of the long-wave identification signal LWIS contained in the data signal DS (with the assistance of the identification values of the transmitter units 31 contained in the data signal DS).

Claims

1. A process for checking the air pressure in the tyres of motor vehicle wheels, in which by means of:

- a measurement unit arranged in or on the tyre of each motor vehicle wheel, at least one pressure signal characteristic of the air pressure is recorded as measurement signal;
- a transmitter unit arranged in or on the tyre of each motor vehicle wheel, a data signal (DS) containing at least one measured value of the air pressure derived from the pressure signal and an identification value characteristic of the respective transmitter unit is generated and emitted;
- a receiver unit arranged at a distance from the motor vehicle wheels, the data signal (DS) emitted by the transmitter units is received;
- a control unit, the identification value of the transmitter unit is compared in the data signal (DS) with the reference identification values allocated to the respective transmitter units in such a way that further processing of the data signal (DS) through the control unit only occurs when the identification value and the reference identification value meet a pre-set allocation criterion;
- the allocation criterion, allocation of the respective position (VL, VR, HL, HR) of the motor vehicle wheel is carried out, in which the variable reference identification value is adapted to the identification value of the respective transmitter unit,

wherein the allocation of the respective position (VL, VR, HL, HR) of the motor vehicle wheel to the data signals (DS) is carried out by means of a bi-directional data transfer process, in which

- an activation signal (AS) generated by the control unit is selectively passed to a respective motor vehicle wheel as a long-wave signal (LWS);

- the long-wave signal (LWS) is respectively received by a long-wave unit arranged in or on each motor vehicle wheel and respectively allocated to a transmitter unit;
- the long-wave signal (LWS) is made available by the long-wave unit to the respectively allocated transmitter unit which generates a long-wave identification signal (LWIS) therefrom;
- a data signal (DS) containing the long-wave identification signal (LWIS) and the identification value of the respective transmitter unit is emitted by the transmitter unit to the control unit as a high-frequency signal, and
- the position (VL, VR, HL, HR) of the motor vehicle wheel is identified by the control unit on the basis of the long-wave identification signal (LWIS).

2. A process according to Claim 1, wherein the long-wave signal (LWS) is passed by the control unit successively to all motor vehicle wheels.

3. A process according to Claim 1 or 2, wherein the activation signal (AS) is generated by the control unit in the presence of specific conditions.

4. A process according to Claim 3, wherein the activation signal (AS) is generated at specific time intervals and/or after a specific distance has been travelled by the motor vehicle and/or depending on the travelling speed of the motor vehicle and/or when the engine of the motor vehicle is started and/or in response to manual request.

5. A process according to any preceding claim, wherein the long-wave identification signal (LWIS) is generated as counter reading of a counter or as a voltage value of an analog integrator.

6. A process according to any preceding claim, wherein the data signal (DS) received by the receiver unit and processed by the control unit is displayed by means of a display unit.

7. A system for checking tyre pressures employing the process according to any preceding claim.

8. A process for checking tyre pressures substantially as herein described with reference to the accompanying drawings.

9. A system for checking tyre pressures substantially as herein described with reference to the accompanying drawings.

The Patent Office

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Application No:	GB 9716499.0	**Examiner:**	Mike Davis
Claims searched:	1-9	**Date of search:**	25 September 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G4H (HNHE)

Int Cl (Ed.6): B60C, G08C

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	EP 0769395 A1 (DELCO)	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.